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BIOCHEMISTRY.—*The determination of glutathione with especial reference to human blood.*[1] WALTER C. HESS, Department of Biochemistry, George Washington University Medical School. (Communicated by M. X. SULLIVAN.)

In 1903 Buffa[2] showed that certain animal tissues give a positive color reaction with sodium nitroprusside and ammonia. This observation was confirmed by Heffter[3] and later by Arnold.[4] The latter suggested that, since the test was given by protein-free tissue extracts, the nitroprusside reaction is due to free cysteine. In 1921 Hopkins[5] succeeded in isolating from yeast, mammalian muscle, and mammalian liver, a substance giving the nitroprusside test. This substance proved to be a dipeptide of cysteine and glutamic acid and Hopkins assigned to it the name glutathione. Due to the presence of the reversible system $H_2 + S-S \rightleftharpoons SH + SH$, this compound assumed great importance in the field of biological oxidation-reduction.

Tunnicliffe[6] devised a method for the estimation of glutathione dependent upon the fact that the SH group could be oxidized by iodine to the S–S group and reported upon the glutathione content of a number of tissues. In rabbit, rat and human blood, however, he was unable to find any glutathione. This finding was in partial agreement, at least, with the earlier report of Hopkins (*loc. cit.*) that glutathione was not present in blood plasma. This result was reported despite the earlier finding of Arnold (*loc. cit.*) that protein-free blood-corpuscle

[1] Received October 8, 1929.

[2] E. BUFFA. Journ. Physiol. Path. Gén. 6: 645. 1903.

[3] A. HEFFTER. Mediz. naturw. Arch. 1: 81. 1905.

[4] V. ARNOLD. Z. physiol. Chem. 70: 314. 1910.

[5] F. G. HOPKINS. Biochem. Journ. 15: 286. 1921.

[6] H. E. TUNNICLIFFE. Biochem. Journ. 19: 194. 1925.

filtrates gave a positive test with sodium nitroprusside and ammonia. This test Arnold attributed to the presence of free cysteine.

A short time after the appearance of Tunnicliffe's work, Holden[7] reported the isolation of 50 mg. of glutathione from a liter of sheep blood. He found the glutathione to be wholly confined to the corpuscles. Harding and Cary[8] the following year used the Folin-Looney cystine method on protein-free filtrates from ox blood. They estimated the glutathione content of ox blood to be approximately 10 mg. per 100 cc. of whole blood. Hunter and Eagles,[9] following the work of Holden, isolated from pig blood-corpuscles a compound yielding cystine and glutamic acid on hydrolysis, but which differed somewhat in analysis from the glutathione of Hopkins. They estimated, using the nitroprusside test, that pig, sheep and cat blood corpuscles contain 100 to 120 mg. of glutathione per 100 cc. of corpuscles.

TABLE 1.—GLUTATHIONE, MG. PER 100 CC. OF WHOLE BLOOD.

	Thompson and Voegtlin	Blanchetiere, Binet and Melon		Brown and Kolmer	Hunter and Eagles	Harding and Cary	Uyei
		Arterial Blood	Venous Blood				
Dog	20	15.4	18.9	29			10
Rat	22			28			25
Hog	31				47		
Beef	35					10	
Calf	36						
Sheep	38						
Rabbit	49			38			30
Guinea pig	49			34			45

Various other workers employing the Tunnicliffe method have investigated the glutathione content of mammalian blood. Table 1 shows the results obtained by Thompson and Voegtlin;[10] Blanchetiere, Binet and Melon;[11] Brown and Kolmer;[12] and Uyei.[13] The results obtained by Hunter and Eagles with the nitroprusside method are shown, as are also the results of Harding and Cary using the Folin-Looney cystine method.

[7] H. F. HOLDEN. Biochem. Journ. **19**: 727. 1925.
[8] T. S. HARDING and C. A. CARY. Proc. Soc. Exp. Biol. Med. **23**: 319. 1926.
[9] G. HUNTER and B. A. EAGLES. Journ. Biol. Chem. **72**: 133. 1927.
[10] J. W. THOMPSON and C. VOEGTLIN. Journ. Biol. Chem. **70**: 793. 1926.
[11] A. BLANCHETIERE, L. BINET and L. MELON. Compt. Rend. Soc. Biol. **97**: 1049. 1927.
[12] H. BROWN and J. A. KOLMER. Journ. Pharmacol. Exp. Therap. **35**: 417. 1929.
[13] N. UYEI. Journ. Infect. Dis. **39**: 73. 1926.

More recently Turner,[14] using the Tunnicliffe method, found an average of 107 mg. per 100 cc. of human corpuscles. Benedict and Newton[15] gave as an average of 18 determinations 55 mg. per 100 cc. of whole blood. Their method is based on the nitroprusside test, similar to that used by Hunter and Eagles, but they state that they regard the figures obtained as of very questionable accuracy. They also doubt whether even a reasonably accurate procedure can be worked out on their modified Hunter-Eagles method.

Considering the variation in these figures it would appear worth while to attempt to determine glutathione by an entirely different method. In work on the estimation of cystine and cysteine at the Hygienic Laboratory two methods have been used: the specific 1,2-naphthoquinone-4-sodium sulfonate test for cysteine and cystine, after reduction by sodium cyanide, developed by Sullivan,[16] and the iodometric method of Okuda.[17] The Okuda method is based upon the fact that cysteine and reduced cysteine (treated with zinc and hydrochloric acid), are oxidized to cystine by potassium iodide and potassium iodate in acid solution. The reaction used is not specific for cystine and cysteine, but will be given by any SH compound and any S−S compound that is reducible by zinc and hydrochloric acid to the SH form.

Glutathione is a compound existing in both the SH and S−S forms, and, therefore, it should be possible to determine it quantitatively by means of the Okuda method. Using the latter, together with the specific reaction for cystine and cysteine devised by Sullivan, it in fact becomes possible not only to distinguish between these various compounds but also to determine them quantitatively.

Various methods for obtaining a protein-free blood filtrate were tested, bearing in mind the finding of Harding and Cary[18] that cystine added to blood was not recovered quantitatively after deproteinizing with trichloracetic acid. Cystine added to blood and then deproteinized by the Folin-Wu[19] method gave varying recoveries dependent upon the amount of cystine added. The procedure was to add the weighed amount of cystine directly to the measured volume of blood (5 cc.) and then precipitate as required by the Folin-Wu procedure.

[14] R. H. TURNER. Proc. Soc. Exp. Biol. Med. **25**: 541. 1929.
[15] S. R. BENEDICT and E. B. NEWTON. Journ. Biol. Chem. **83**: 361. 1929.
[16] M. X. SULLIVAN. U. S. Public Health Reports **41**: 1030. 1926.
[17] Y. OKUDA. Journ. Biochem. (Tokyo) **5**: 201. 1925.
[18] T. S. HARDING and C. A. CARY. Journ. Biol. Chem. **78**: xlix. 1928.
[19] O. FOLIN and H. WU. Journ. Biol. Chem. **38**: 81. 1928.

A known amount of the protein-free blood filtrate, the reaction of which was approximately pH 7, was brought to pH 3.5 with normal hydrochloric acid. The cystine content was determined colorimetrically as follows: To 5 cc. of the solution add (a) 2 cc. of 5 per cent aqueous sodium cyanide, wait ten minutes, add (b) 1 cc. of a freshly prepared 0.5 per cent aqueous solution of 1,2-naphthoquinone-4-sodium sulfonate, mix, and add (c) 5 cc. of a 10 per cent solution of anhydrous sodium sulfite in 0.5 N sodium hydroxide, mix, and wait 30 minutes. Then add (d) 1 cc. of a 2 per cent solution of sodium hyposulfite ($Na_2S_2O_4$) in 0.5 N sodium hydroxide. A solution of cystine of known concentration treated in the same manner was used as the standard for comparison in a Klett biocolorimeter. Using the recently published method of Benedict and Newton[20] for obtaining protein-free blood filtrates, the same experiment was repeated with better recoveries of added cystine. The results, using both methods of protein precipitation, are shown in Table 2.

TABLE 2.—RECOVERIES OF CYSTINE ADDED TO BLOOD

Blood, cc.	Cystine added, mg.	Cystine recovered, mg.	
		Folin-Wu	Newton-Benedict
20	6	2.1	5.7
20	4	1.1	3.8
20	2	0	1.9

With recoveries of added cystine well within the limit of error of the method, the possibility remained that some of the cystine found came from the blood itself. An experiment was therefore performed to determine whether or not human blood contained any free cystine or cysteine. Several methods for deproteinizing were used—first the Folin-Wu, second, the Benedict-Newton, and, third, a new method involving the use of anhydrous sodium sulfate. The protein-free filtrates obtained by both the Folin-Wu and Benedict-Newton methods were adjusted to pH 3.5 and tested for cystine and cysteine by the Sullivan method, with negative results.

The two filtrates each represented a ten to one dilution of the blood and so might be too dilute and thus below the order of reactivity of the method. However, on concentrating both filtrates, under reduced pressure, back to the original blood volume, adjusting the reaction to pH 3.5, and again applying the Sullivan method for cystine and cysteine, neither was found.

[20] S. R. BENEDICT and E. B. NEWTON. Journ. Biol. Chem. **83**: 357. 1929.

The sodium sulfate method, which Sullivan and Hess, in work to be published, have found to give good results with tissues with only a two to one dilution, was next employed. The procedure is as follows: To 5 cc. of blood in a 150 cc. mortar add 3 grams anhydrous sodium sulfate and 5 cc. 10 per cent sulfuric acid dropwise, and with continual grinding. Filter, using a Buchner funnel and hard paper, scrape the material from the filter paper, and put it back into the mortar with 0.5 gram of anhydrous sodium sulfate, adding another 2.5 cc. of 10 per cent sulfuric acid and grinding. Then filter as before, bringing the combined filtrates to pH 3.5 with a few drops of 5 N sodium hydroxide, added dropwise and with constant stirring. The Sullivan method applied to 5 cc. of this filtrate also showed the absence of both cysteine and cystine. These experiments were all performed on relatively fresh blood, three of the samples being precipitated within a few minutes after drawing the blood and two within one hour after drawing the blood. The specificity of the Sullivan reaction has been discussed in papers by Sullivan[21] and Sullivan and Hess,[22] and it can be concluded with a high degree of probability that within the limits of the methods at hand, human blood is lacking in both cystine and cysteine.

The Okuda method, as applied to the determination of glutathione, requires the following solutions:

(1) $\frac{M}{1200}$ potassium iodate made by dissolving 0.5350 g. potassium iodate in 3 liters of 2 per cent hydrochloric acid.
(2) 4 per cent hydrochloric acid.
(3) 5 per cent aqueous potassium iodide.

Ten cubic centimeters of the protein-free filtrate, obtained by the Benedict-Newton method, are made to exactly 2 per cent with concentrated hydrochloric acid, 2.5 cc. of the 5 per cent potassium iodide are added and 2.5 cc. of the 4 per cent hydrochloric acid solution. The solution is then cooled to 20°C. and titrated with $\frac{M}{1200}$ potassium iodate until a yellow color appears and persists for one minute. During the titration the temperature is not allowed to rise over 20°C. This is important, as large errors are introduced by not maintaining a constant temperature. The $\frac{M}{1200}$ potassium iodate is standardized

[21] M. X. Sullivan. U. S. Public Health Reports **44**: 1030. 1929.
[22] M. X. Sullivan and W. C. Hess. U. S. Public Health Reports **44**: 1599. 1929.

against reduced glutathione dissolved in 2 per cent hydrochloric acid, 10 cc. of that solution being titrated exactly the same as 10 cc. of the protein-free blood filtrate.

This method determines only the reduced glutathione. To determine the oxidized glutathione it is necessary to reduce the S−S grouping to the SH form. The procedure for this is as follows: To 10 cc. of the filtrate add 1.0 cc. of concentrated hydrochloric acid and a few decigrams of zinc powder and boil gently for 10 minutes. Filter and wash thoroughly. Adjust the acidity of the filtrate to exactly 2 per cent with concentrated hydrochloric acid, add 2.5 cc. of 5 per cent potassium iodide and 2.5 cc. of 4 per cent hydrochloric acid and cool to 20°C. The titration is the same as for reduced glutathione. Table 3 shows the results for 5 samples of normal blood.

TABLE 3.—GLUTATHIONE

Milligrams per 100 cc. whole blood

Blood	Before reduction	After reduction
1	58	61
2	55	58
3	64	66
4	60	63
5	59	63

TABLE 4.—CYSTINE

Milligrams per 100 cc. whole blood

Blood	Sullivan	Okuda	Theoretical
1	26.9	27.3	29.3
2	24.3	25.0	27.8
3	28.5	29.1	31.7
4	27.7	28.3	30.2
5	27.4	28.5	30.2

Glutathione is considered as being a dipeptide of cystine and glutamic acid and should, on hydrolysis, yield these two amino acids. The amount of glutathione originally present can then be determined by using the Sullivan method to estimate the cystine in the hydrolysate. By hydrolyzing a blood filtrate and determining the cystine in the hydrolysate it should be possible to check the findings by the Okuda method. Accordingly another portion of the same filtrate was concentrated under reduced pressure to the original blood volume, made to 20 per cent acidity with concentrated hydrochloric acid, and hydrolyzed at 125°C. for six hours. The hydrolysis was carried out in an acetylation flask immersed in an oil bath. The hydrolysate was colorless, and was poured into a beaker, the flask washed and the washings added to the beaker. The solution was brought to pH 3.5 with 5N NaOH, added dropwise with stirring. Cystine was determined in this solution by the Sullivan method and also by the Okuda method. The results agree within less than 10 per cent of the amount required for the glutathione present. The results are shown in Table 4.

The only substance known to exist in blood that might possibly be thought to interfere in the Okuda method is ergothioneine. However, the sample of ergothioneine in the laboratory did not react in Okuda's method until it had been reduced with zinc and hydrochloric acid. It could not, therefore, interfere in the determination of reduced glutathione, which has been found to be 95 per cent of the total glutathione, if the analysis is performed within one hour after drawing the blood. The factor on the $\frac{M}{1200}$ potassium iodate for 10 mg. reduced glutathione is 6.48 cc., while for 10 mg. ergothioneine after reduction it is only 0.03 cc. The amount of ergothioneine in 100 cc. of human blood averages about 7.5 mg., according to Behre and Benedict.[23] The titer, then, for the amount present in one or two cc. of blood is negligible. However, a method for eliminaing ergothioneine has been devised and will be described in a later paper.

Summary.—A method for the determination of glutathione in blood has been described. The average amount found in normal human blood is 59 mg. before reduction and 62 mg. after reduction. No cystine nor cysteine was found in normal human blood. The method has been found to be more accurate than the Tunnicliffe outside indicator method, and is being applied to a number of pathological bloods.

PALEONTOLOGY.—*A new Eocene* Leda *from Black Bluff, Alabama.*[1]

JULIA A. GARDNER, U. S. Geological Survey.

Through the interest and generosity of Dr. Walter B. Jones, the State Geologist of Alabama, I had the good fortune in late July of 1929, to join a small party from the University of Alabama on a two-day collecting trip to Black Bluff, Sumter County, on the Tombigbee River about 15 miles in an air line below Demopolis and 2½ miles below the mouth of Sucarnoochee Creek. Black Bluff is a superb exposure extending for fully half a mile along the western bank of the Tombigbee. Under the caption, "The Black Bluff or Sucarnochee Series," the section was described by Dr. E. A. Smith[2] over thirty years ago, the fossils having been listed even earlier by Truman H. Aldrich.[3] Ever

[23] J. A. BEHRE and S. R. BENEDICT. Journ. Biol. Chem. **82**: 11. 1929.

[1] Published by permission of the Director, U. S. Geological Survey. Received October 5, 1929.

[2] EUGENE A. SMITH, LAWRENCE C. JOHNSON, and DANIEL W. LANGDON, JR. Ala. Geol. Survey Rept., Geology Coastal Plain Ala. 186. 1894.

[3] TRUMAN H. ALDRICH. Ala. Geol. Survey Bull. 1: 60. 1886.

since that time, it has served as a valuable check both lithologically and faunally for the Sucarnoochee clay, the middle formation of the Midway, the lowest group in the Eocene.

Unlike so many of the older localities, Black Bluff is today easily recognizable from the early descriptions, though it may have suffered a certain amount of slumping from the first altitude estimate of eighty feet. The heavy shingle of limonite concretions near the water's edge, a feature mentioned by Doctor Smith, is still a striking character. The bed is uncommonly persistent, for flood waters would certainly have washed away a softer series during thirty-five years. A ferruginous conglomerate made up largely of fucoidal concretions is characteristic of the upper end of the Bluff. Organic remains, particularly *Trochocyathus hyatti* Vaughan, are superficially embedded in largenumbers upon the upper surface. Other flattened concretions of irregular outline, resembling masses of small shot and possibly containing some barite, are fairly common. Rosettes of selenite crystals are abundant in the upper part of the section at the lower end of the bluff. Although in the greater part of the section they are not sufficiently calcareous to react to acid, the clays contain, locally, numerous lime nodules. The clay is a true gumbo, slaty black, very fine and homogeneous, breaking with a conchoidal fracture, massive and impossible to walk upon when wet, splitting and spreading on drying like thick leaves of a heavy book.

The Black Bluff fauna is small and, to a certain extent, segregated. Crustacean remains are most common at the upper end of the Bluff, about fifteen to twenty feet above the base of the ledge which outcrops at the river margin at moderately low water. Small univalves, particularly turritids, are fairly plentiful just above the crustacean bed. Some of the turritids are new but too imperfect to warrant description. *Volutocorbis rugatus* (Conrad), *Olivella*, possibly *mediavia* Harris, an indeterminate naticoid, and a new but imperfect species of *Architectonica* were collected from the same section but eight to ten feet below the crabs. It is highly probable that this gastropod zoning is due in large part to the accidents of collecting, although the crustaceans seem to be confined in large measure to a single definite horizon. Bivalves are relatively rare at the upper end of the Bluff but very large and well preserved *Nucula mediavia* Harris, *Leda* (*Ledina*) *jonesi* new species and *Cucullaea macrodonta*, together with *Enclimatoceras* fragments, are fairly common a quarter to half a mile downstream. *Trochocyathus hyatti* Vaughan, a small solitary coral, is perhaps the only

form fairly common throughout the vertical section and the entire length of the outcrop. One of the most remarkable features of the Black Bluff fauna is the apparent absence of *Venericardia* and *Turritella*, by far the most conspicuous groups both in the Clayton limestone beneath and in the Naheola above. Not a fragment of either genus was observed nor has any species been reported by Aldrich or by Harris. Habitat and not the time element was apparently the determining factor in excluding these two genera so prominent in the Midway life. Shallow but undisturbed waters probably covered the silty bottom. Deep-water conditions would have made life impossible both for the corals and the crabs, and an inrush of sediment would have buried the corals, the most prevalent forms in the fauna.

Figure 1. *Leda* (*Ledina*) *jonesi* n. sp.[4] × 2.

Leda (Ledina) jonesi Gardner, new species

1896. *Yoldia eborea* Conrad. Harris, Bull. Am. Paleontology **1** (No. 4): 56, pl. 4, fig. 7 (ex parte).

1898. *Leda* (*Ledina*) *smirna* Dall, Wagner Free Inst. Sci. Trans. **3** (pt. 4): 578, 580 (ex parte).

Shell large for the genus, *Yoldia*-form, moderately heavy and well polished, smoothly and rather strongly inflated. Umbones submedial, obtuse but fairly prominent, the tips incurved and almost in contact. Lunule narrow, half as long as the anterior dorsal margin, defined by the smooth surface and the pinched margin. Escutcheon similar in general outline and surface to the lunule but longer and wider, more sharply delimited and extending more than two-thirds of the distance to the posterior extremity; both lunule and escutcheon framed by faint rays which are produced almost to the lateral margins. Anterior half of shell obliquely truncate dorsally, rounding laterally into the broadly arcuate base. Posterior half of shell constricted behind the umbones, relatively narrow but rounded at the posterior extremity. Outer surface smooth excepting for incrementals and a microscopically fine and regular concentric striation. Chondrophore small, trigonal, set deep beneath the umbones. Hinge teeth strong, taxodont, from 20 to 25 in both the anterior and the posterior series. Muscle scars rather obscure, the anterior larger and broader than the posterior. Pallial line inconspicuous, simple.

Dimensions.—Altitude, 13.6 millimeters; latitude, 27.1 millimeters; diameter, 10.9 millimeters.

[4] The line drawings were made by Miss FRANCES WIESER.

Holotype.—U. S. Nat. Mus. No. 371067.

Type locality.—Black Bluff, Tombigbee River, sec. 12, T. 16, R. 1 W., Sumter County, Alabama.

Leda jonesi is one of the most common species in the small Black Bluff fauna. Though well represented in the early collections, it was included under "*Yoldia eborea*" Conrad, later *Leda smirna* Dall. Harris (*op. cit.*, 56) noted, however, that "there is considerable variation in the size as well as the shape of this species. The Tombigbee River specimens are larger and longer than those from the Alabama River exposures." The larger size, less trigonal outline, more rounded posterior extremity, and less arcuate ventral margin are sufficiently distinctive to justify the separation of the Black Bluff species from *Leda smirna* of the Matthews Landing, Alabama River, fauna. The differences are significant, for Black Bluff offers the type section of the Sucarnoochee clay while Matthews Landing is the most highly fossiliferous outcrop of the overlying Naheola formation.

I have the pleasure of naming this species in honor of Dr. Walter B. Jones, the State Geologist of Alabama.

ZOOLOGY.—*Field notes and locality records on a collection of amphibians and reptiles chiefly from the western half of the United States. I. Amphibians.*[1] CHARLES E. BURT and MAY DANHEIM BURT, American Museum of Natural History. (Communicated by LEONHARD STEJNEGER.)

During the course of an automobile tour through the western half of the United States, from June 10 to September 15, 1928, the opportunity was taken to collect as many amphibians and reptiles as the time allowed. The following account has been prepared in order to make the locality records obtained available to students of distribution and to put into permanent form the numerous field observations made during the course of the collecting. Every effort has been made to make the determination of species as accurate as possible, but critical taxonomic notes on details of coloration and scutellation have usually been omitted, since in most cases this type of information may best be given by subsequent revisers of the genera concerned.

The opportunity has been taken to include here a series of about forty specimens from the authors' personal collection.[2] All of the specimens here reported, with the exception of a number used in per-

[1] Received October 3, 1929.

[2] Records based on specimens not taken by the authors are associated with the names of the collectors.

sonal exchanges or as gifts to other institutions, are being deposited in the Museum of Zoology of the University of Michigan.

To a number of friends who have generously spent time in the field with us we extend our grateful appreciation. We are especially indebted to Mr. and Mrs. Oliver Millard of San Francisco; Mr. L. M. Klauber of San Diego; Dr. A. P. Williams of Neodesha, Kansas; Mr. W. H. Burt of the Museum of Vertebrate Zoology of the University of California; Mr. and Mrs. Earle M. Landholm of Bristow, Nebraska; and Mr. Howard Shaffer of Haddam, Kansas; likewise, to Dr. Frank N. Blanchard for his kind criticism of this work. Assistance has been obtained from the Museum of Zoology of the University of Michigan.

LIST OF SPECIES

Salamanders

Ambystoma tigrinum (Green).—A large specimen of the tiger salamander, still in the larval state, was collected on Aug. 28 in the muck of a shallow roadside pond 3 miles southeast of Park City, Summit County, Utah.

An adult was found in a tub of rainwater on September 14 at a farm 8 miles north of Bristow, Boyd County, Nebraska, and another adult was observed on the floor of a cellar at the same place, but it escaped by going into an earthen tunnel at the side of the steps.

Batrachoseps attenuatus attenuatus (Eschscholtz).—Two of these little, pinkish salamanders were found on August 12 under rocks in the bed of a small streamlet which flows down the side of Mt. Diablo, Contra Costa County, California. Here, curled up in the damp sand and gravel, they resembled earthworms.

Several large specimens were obtained on August 13 under rocks in a fern bed which had been watered all summer at 217 Upper Terrace, San Francisco, San Francisco County, California.

Toads

Bufo americanus Holbrook.—The males of this species were calling on June 12. Specimens were taken at the edge of the Vermillion River near La Salle, La Salle County, Illinois, and at Deer Park, 6 miles east of La Salle.

Bufo cognatus cognatus (Say).—Nine of these toads were found trapped in the stagnant water of an irrigation sluice 7 miles northwest of Tucson, Pima County, Arizona.

Bufo compactilis Wiegmann.—A large adult was collected on the muddy road at Nulo, El Paso County, Texas, just after a mountain shower which came late in the evening of July 16.

Bufo woodhousii Girard.—These toads are usually abundant where they occur and are easily taken on rainy days. However, when the sun shines they find shelter by burrowing in some damp location, preferably in sand or loose loamy soil, or by hiding beneath loose boards, fallen trees, logs, or other objects. They are frequently seen close to dwellings and in many places they are called "garden toads." The habit of coming from their retreats at night to hop on the road or to sit beneath a street light to catch the insects upon which they prey often results in their death, as evidenced by the number of their flattened bodies to be found at times on some of the main traveled highways.

At Bristow, Boyd County, Nebraska, where a bend of Ponca Creek has been cut off to produce the stagnant "Dead Creek," hundreds of transforming young, tailed to tailless, were observed on the night of June 16, and many were collected. They were particularly abundant on the extensive mud-flats which surrounded this cut-off, although many were on the masses of aquatic vegetation which floated upon the surface of the water. Adults were collected near these young as well as on the side-walks and in the gardens of Bristow. Specimens were also found in an orchard 2 miles to the northeast and along a roadside 5 miles to the north of town.

In Kansas, several specimens were taken at Blue Rapids in Marshall County, and both young and adults were secured on a farm 5 miles north of Haddam in Washington County on June 27, and again on a creek bank 3 miles northeast of Haddam on September 1. The young were all tailless and much larger on the second date. On the afternoon of April 30, 1927, many males were observed congregated in a temporary meadow pool near the Big Salt Marsh in Stafford County. This latter date is probably within the earlier days of the mating period.

Large specimens were taken on the road at Ft. Hancock, El Paso County, Texas, and 1 mile northwest of Canutillo (also in El Paso County). In the latter place they were less than 300 feet from the Rio Grande.

FROGS

Acris gryllus (Le Conte).—This little frog is very common in the middle west in the typical part of its range and frequents a great variety of habitats. Here it may be found at almost any place where there is permanent water—in springs, along water courses, at the edges of ponds, or in marshes, in either clear or muddy, and running or stagnant water. In most places cricket frogs are associated with *Rana pipiens*, although they sometimes occur alone, particularly in the vicinity of the smaller prairie springs. When in danger individuals usually attempt to escape detection by hiding under aquatic vegetation or debris, but at times they hop into some secluded spot upon the bank or upon a surface mat of algae, etc., where they remain perfectly motionless, relying solely upon their concealing coloration and their readiness to change their position for protection. There is remarkable variation in the dorsal ground color of these creatures, even in one locality—many shades and combinations of black, gray, brown, green and yellow being in evidence in large series of living individuals.

In MICHIGAN, specimens were taken 8 miles west of Kalamazoo, Kalamazoo County. — In ILLINOIS at Deer Park, 6 miles east of La Salle, La Salle County; and 10 miles northwest of Elizabeth, Jo Daviess County. — In IOWA, 3 miles southwest of Cedar Falls, Blackhawk County. — In NEBRASKA, 7 miles east of Brunswick and 2 miles north of Oakdale, Antelope County; Ponca Creek and "Dead Creek"[3] near Bristow, Boyd County; 10 miles south of Beatrice, Gage County; pool on right bank of the Niobrara River near the Bristow Dam and Riverside Park, northern Holt County; 7 miles west and a little south of Norfolk, Madison County; and 1 mile west of Osmond, and 8 miles south of Columbus, Pierce County. — In KANSAS, 5 miles south of Clifton, Clay County; 4 miles northwest of Richmond, Franklin County; 2 miles west of Waterville, Marshall County; and from 6 miles east of Haddam, 6 miles north of Haddam, Nutch's Pond (2 miles east of Haddam), 4 miles southeast of Haddam, 7 miles southeast of Enosdale, Morrowville, and just west of Washington, in Washington County. — In OKLAHOMA, 16 miles north of Coalgate, Coal County; and Owen, Washington County. — In TEXAS, 7 miles south of Eola, Concho County; 5 miles southwest of Cove, Coryell County; 6 miles east of Rochelle, McCulloch County; and 2 miles south of Lorena, McLennan County.

[3] See mention of this creek under *Bufo woodhousii*, p. 428.

Hyla regilla Baird and Girard.—We took this frog only in San Francisco County, California, and only on the afternoon of August 19. At Lake Merced, near Ingleside, ten individuals were taken from the stems of reeds and rushes at the edge of the water.

A series of 87 specimens was secured in a short time along the banks and in the pools of Islais Creek, just below Mission Bridge, in San Francisco. This creek ordinarily carries a small amount of water and the flow is not rapid. At the point where our specimens were taken there was a rock bottom, but this was often covered over by mud. There were many side pools which were often covered by a combination growth of algae, moss, and duckweed, on the surface of which many frogs were found. Individuals often attempted to escape by diving below this mat of surface vegetation. Tadpoles were seen in the water and metamorphosing forms were found both in the water and out of it.

Down stream, a short distance below Mission Bridge, a sewer empties into Islais Creek, and below this point *Hyla* was not found. Here the aquatic vegetation becomes scanty, the water impure, and the bottom of the stream filled with a barren, black sludge, which is often of considerable depth.

Rana aurora draytonii (Baird and Girard).—Mr. Oliver Millard has sent us a specimen of this form which he collected at a small pond near a stream which flows into Lake Merced, near Ingleside, San Francisco County, California.

Rana boylii boylii (Baird).—On the road from San Rafael to Bolinas in Marin County, California, at a point about 6 miles west of San Rafael, four of these little frogs were found near a roadside spring from which a small streamlet of clear water trickled over a bed of stones and gravel.

Others were secured at the edge of Lake Merced, San Francisco County, California, in moist, but relatively open places. Here two methods of escape were observed: (1) Diving into the water and hiding there under the cover of aquatic vegetation, and (2) jumping into the thickets of land vegetation on the banks above the shore line.

Rana boylii sierrae Camp.—This subspecies was found to be abundant in the vicinity of a fair-sized mountain stream which runs alongside the road from Placerville to Lake Tahoe in Eldorado County, California, at a point about 40 miles west of Lake Tahoe. There was very little vegetation along the broad stream, which flowed moderately and with a depth varying from one to three feet. The bed of the

stream, easily seen through the clear water, was essentially of stones, gravel and sand. The frogs were usually resting at the water's edge, but they jumped into the water and hid under stones as we approached. A number were secured with the fingers after they had been pinned to the rocks under which they were seen to take refuge or after they had been trapped in some under-water crevice.

Mr. Oliver Millard has recently sent us a series of this form which he collected in the Sierra Nevada Mountains along a tributary of the north fork of the Stanislaus River at an elevation of 6500 feet, 15 miles northwest of Calaveras, Calaveras County, California.

Rana catesbeiana Shaw.—Bullfrogs are common along the banks of the larger ponds and streams of the middle west. They are not as widespread in their occurrence here as *Rana pipiens* and *Acris gryllus*, with which they are usually found. Specimens of *Rana catesbeiana* were taken at Nutch's Pond (2 miles east of Haddam), Washington County, and along the banks of the Verdigris River, 4 miles northeast of Neodesha, Wilson County, in KANSAS; and at Owen, Washington County, in OKLAHOMA.

Rana clamitans Latreille.—The green frog was taken only in Illinois. It was found near rather deep pools in Deer Park, 6 miles east of La Salle, La Salle County; and along a stream 10 miles northwest of Elizabeth, Jo Daviess County.

Rana palustris Le Conte.—An adult of this species was collected 10 miles northwest of Elizabeth, Jo Daviess County, Illinois, at the edge of a small, wooded stream, Smallpox Creek.

Rana pipiens Schreber.—The leopard frog is the most common amphibian of the middle west, due, perhaps, to its ability to adapt itself to a great variety of habitats and habitat conditions. It may occur in either clear or muddy water; in shallow ponds or in deep ones; in springs, in creeks or in rivers; and in the mountains or in the lowlands. Its distribution in the typical part of its range seems to be limited only by its ability to reach the permanent bodies of water.

When disturbed, individuals dive beneath aquatic debris, rush into clumps of reeds or sedges in the water, or seek shelter in the weeds or grasses of the bank. They seem to be much more wary in some localities than at others and are always harder to secure at the higher temperatures.

We have often noticed that after the mating season rain causes the amphibian population to spread out, whereas a continued dry period causes it to concentrate about bodies of water or in moist situations.

Thus, on June 27, but a short time after a rain, an adult *Rana pipiens* was found near Haddam, Kansas, high on a hillside above a pond; on June 30, after more rain, specimens were found in the woods, buckbrush, and prairie above a creek near Clifton, Kansas; and on July 16, just after a mountain shower, one was taken from a sandy road at Fort Hancock, Texas.

Two albino frogs of this species were collected with a dip net 3 miles south of Patagonia, Arizona, on July 20. In life these individuals were clear pink and many of their blood vessels could be readily seen. One was a large tadpole and the other was in the transforming stage. The external mouth parts of the tadpole were black, but those of the other albino were pinkish. Typical dorsal spots were present on the transforming specimen as perceptibly darker areas, edged with white.

In ILLINOIS, specimens were taken at La Salle, and in Deer Park, 6 miles east of La Salle, La Salle County. — In IOWA, 3 miles southeast of Cedar Falls, Blackhawk County. — In NEBRASKA, 7 miles east of Brunswick, Antelope County; Bristow, "Dead Creek"[4] and 5 miles northeast of Bristow, Boyd County; 10 miles south of Beatrice, Gage County; pool on right bank of the Niobrara River near Bristow Dam and Riverside Park, northern Holt County; 1 mile east of Osmond, Pierce County; and 8 miles south of Columbus, Platte County. — In KANSAS, 4 miles south of Clifton, Clay County; 4 miles northwest of Richmond, Franklin County; 2 miles west of Waterville, Marshall County; 3 miles east of Prairie View, Phillips County; 6 miles east of Haddam, 6 miles north of Haddam, 3 miles northeast of Haddam. 5 miles southeast of Haddam, 1 mile west of Haddam, Nutch's Pond (2 mi. east of Haddam), just north of Morrowville, 2 miles east of Strawberry, and Washington, Washington County; and Verdigris River, 4 miles northeast of Neodesha, Wilson County. — In TEXAS, Ft. Hancock, El Paso County; 2 miles northwest of Toyahvale, Reeves County; and 2 miles southwest of Big Lake, Tom Green County. — In ARIZONA, 3 miles southwest of Patagonia, Santa Cruz County. — In COLORADO, 3 miles northwest of Deertrail, Arapahoe County; 3 miles east of Denver, Denver County; 2 miles east of Flagler, Kit Carson County; and Bear River, 9 miles east of Craig, 1 mile north of Hayden, 1 mile northwest of Steamboat Springs, and 5 miles northwest of Steamboat Springs, Routt County. — In UTAH, 3 miles southwest of Park City, Summit County; and 4 miles east of Fort Duchesne. Uintah County.

[4] See mention of this creek under *Bufo woodhousii*, p. 428.

ZOOLOGY.—*A new antelope squirrel from Arizona.*[1] E. A. GOLDMAN, Bureau of Biological Survey.

Further study of the mammals of Arizona has resulted in the detection of a hitherto unrecognized antelope squirrel in the Grand Canyon of the Colorado River. The new form is of considerable interest in tracing the distribution of species in that remarkable region. It is described subspecifically as follows:

Ammospermophilus leucurus tersus, subsp. nov.

Grand Canyon Antelope Squirrel

Type.—From lower end of Prospect Valley, Grand Canyon, Hualpai Indian Reservation, Arizona (altitude 4,500 feet). No. 202645, ♂ young adult, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, October 3, 1913. Original number, 22269.

Distribution.—Terraces along the southern side in Grand Canyon, on the Hualpai Indian Reservation, Arizona. Upper Sonoran Zone.

General characters.—Resembling *Ammospermophilus leucurus cinnamomeus*, but smaller; color usually darker, the sides of body below white stripes more heavily mixed with black; skull with distinctive details, especially the lighter dentition. Similar in size to typical *A. l. leucurus*, but color much darker, the back less heavily overlaid with gray; skull essentially as in *leucurus*.

Color.—*Type* (anterior half of body in worn summer pelage, posterior half acquiring winter coat): Top of head, neck, shoulders, and anterior part of back light cinnamon brownish, mixed with gray, the brownish element predominating on head; posterior part of back, rump and outer sides of hind limbs near mikado brown, finely and rather inconspicuously mixed with white; sides of body below usual white stripes near mikado brown, moderately mixed with black; under parts, including inner sides of limbs, white; outer sides of forearms light pinkish cinnamon, this color passing down and gradually fading out on toes of forefeet; upper surface of hind feet dull white, tinged along outer side with light pinkish cinnamon; tail above mikado brown at base, thence mixed black and white, the lateral margins and extreme tip pure white, below white, with a conspicuous, subterminal black band.

Skull.—About like that of *A. l. leucurus*, but rather small, with narrow nasals, and narrow interorbital space. Similar to that of *A. l. cinnamomeus*, but smaller; dentition lighter; molariform toothrows decidedly shorter.

Measurements.—*Type:* Total length, 208 mm.; tail vertebrae, 67; hind foot, 38.5. Average and extremes of nine full grown males and females, including type, from type locality: 204 (194–214); 62 (54–72); 39 (38–40); *Skull* (type): Greatest length, 37.6; condylobasal length, 34.8; zygomatic breadth, 22.2; breadth of braincase (at notch behind zygomata), 18.1; interorbital breadth, 9.2; least postorbital breadth, 13.5; length of nasals, 10.6; maxillary toothrow, 6.3.

Remarks.—In the Grand Canyon of the Colorado River, which bisects the high plateau region of northern Arizona, antelope squirrels are restricted mainly to the broader terraces bordering the inner gorge. These terraces are

[1] Received October 3, 1929.

cut at frequent intervals by side canyons, some of which extend with sheer walls to the nearly or quite precipitous outer rim of the main canyon. The higher parts of the Coconino Plateau along Grand Canyon are unsuited to the needs of antelope squirrels and the side canyons mentioned, while not absolute barriers at their heads, evidently tend to break the continuity of range within the main canyon.

Specimens from Indian Gardens, on the broad terrace along the inner gorge at 3,800 feet altitude on the south side near the end of the Grand Canyon Railroad, are darker and richer in color than typical *A. l. cinnamomeus* and may be grading toward the form here described, but in cranial characters agree with the former. Some specimens from localities in northwestern Arizona, north of the Grand Canyon are similar to the Prospect Valley animal in cranial details and are not widely different in color, but are evidently more nearly intermediate between *A. l. leucurus* and *A. l. cinnamomeus*. The restricted range of *A. l. tersus* is closely approached on the west, beyond the Grand Wash Cliffs, by the wide distribution area of *Ammospermophilus harrisii*, a related but apparently quite distinct species. The narrow gap between the known ranges of the two has not been thoroughly explored, but appears to be a barrier formed by high spurs of the plateau, extending to sheer or uninhabitable canyon walls.

Specimens examined.—Ten, all from the type locality.

ZOOLOGY.—Neoaplectana glaseri, *n.g., n.sp.* (*Oxyuridae*), *a new nemic parasite of the Japanese beetle* (Popillia japonica *Newm.*).[1]

G. STEINER, Office of Nematology, Bureau of Plant Industry.

In a lot of fourteen dead larvae of the Japanese beetle[2] submitted to him for a diagnosis as to the cause of the death, Dr. R. W. Glaser of the Rockefeller Institute for Medical Research at Princeton, N. J. found thousands of nemas. These were sent to the writer for identification.

The form seems to be new, belonging not only to a new species but also to a new Oxyurid genus exhibiting close relationship to the genera *Aplectana* and *Steinernema*. The present paper deals only with the description of the new form; the life cycle and economic significance of the parasite will be studied by Dr. Glaser himself. It is the first time, so far as we know, that a nema has been observed parasitizing the Japanese beetle. The question as to the origin of this parasite also is of interest. Is it a native of Japan? Was it brought to this coun-

[1] Received October 9, 1929.

[2] Kindly sent by Dr. HENRY FOX, of the U. S. Japanese Beetle Laboratory at Moorestown, N. J.

try with the first immigrating Japanese beetle, or did it come later with the introduction of some other parasites of its host in an accidental way? This is not known. Another possibility is that the parasite has as an original host some native insect or insects, and adapted itself only recently to the Japanese beetle. It would be strange if this parasite had in the past escaped the efforts of the numerous entomologists studying that insect, and has only now come to their attention. The view that we have here a case of an attack of some native parasite on the immigrant therefore seems more probable. Dr. Glaser states that the larvae of the beetle were swarming with specimens of the parasite, larvae as well as adult males and females.

Neoaplectana glaseri, n. g., n. sp.

The larval Neoaplectanas are very slender, in a less degree also the males, but the females are thick and plump. The tail end of the larva is long-conical and sharply pointed (Fig. F); that of the female, however, is short-conical with a blunt end (Fig. G). The tail of the male is different, being broad-obtuse (Figs. H and I). The cuticle is thin, not annulated and not striated. There are no lateral wings, a character which differentiates this genus from *Aplectana* (Railliet et Henry, 1916). No deirids but phasmids were seen. The head is not set off. There are three indistinct lips; each of them has two protruding papillae, all together forming an anterior or labial circle of papillae. Back of them, however, is a second circle of papillae,—the cephalic papillae,—which do not protrude. They are difficult to see in a side view, and are best located in a front view. The amphids are perhaps the most noticeable organs of the head end. They are shifted dorsad to the same level with the lateral papillae. The amphidial pouch is a slightly conical tube (Fig. B); terminals were seen but their number could not be made out. Two short setae were seen ventro-submedial, one on each side at about the level of the cephalic papillae. Their significance is unknown (Fig. E). There is no buccal cavity. The anterior part of the oesophagus is cylindroid; a faint isthmus connects with the terminal bulb. At the anterior end of the oesophagus the outlets of three salivary glands were seen. The terminal bulb is rather weak and the ribbed valvulae are indistinct. The intestine consists of a single layer of flat cells. In the larvae, these are filled with granules, except three or four cells just following the oesophageal bulb. In the adult, however, the intestine seems degenerate. The nerve-ring circles the oesophagus in front of the terminal bulb. The excretory pore opens ventrad of the nerve-ring. The female sexual apparatus is amphidelph (Seurat 1920). The ovaries are apparently reflexed. The uterus extends far forward and backward, often reaching and even passing the terminal bulb of the oesoph-

agus. Larvae and eggs in all different stages of cleavage are seen simultaneously in the uterus. Perhaps the present species represents a case closely approaching what Seurat (1920) terms "endothokis matricide." It is very probable that most of the larvae hatch only after the mother is dead. The male has a single testis, stretched out forward but ending some distance behind the beginning of the intestine. The entire male apparatus has a right lateral position. Only the end portion of the ductus ejaculatorius lies ventrad. The spicula are large and arcuate, the distal end is slightly cephalated and forms a hook; the gubernaculum is large, its distal part lineate, the proximal, however, broadly swollen (Fig. H). The arrangement of the muscles of the male apparatus may be seen in Fig. H. The number of the protruding and nipple-shaped copulatory papillae is large. There are postanal and preanal papillae. There is a single preanal ventro-medial papilla some distance in front of the anus. A series of seven ventro-submedial papillae, beginning at the anus, extends about three and one-half times the length of the spicula in front of it; a single lateral papilla is located just in front of the anus. On the tail there are always two ventro-submedial papillae close to the end and a dorso-submedial one in the same region; in some specimens one or two additional ventro-submedial papillae were seen.

It will be noted from this description that the present form exhibits a close relationship to *Steinernema kraussei* (*Aplectana kraussei* Steiner 1923). The general shape of the body, but especially the spicula and the gubernaculum, are almost the same, yet the number and arrangement of the head sense organs are very different, *Steinernema* having but a single circle of four submedial papillae, whereas *Neoaplectana* has two circles of six each. In addition, the number of male copulatory papillae is much larger in *Neoaplectana* and their arrangement is very different. *Aplectana*, on the other hand, has lateral wings and a pointed tail end in the male, characters in which it differs from the present genus.

Neoaplectana belongs ecologically, probably, to a group of nemas, the hosts of which are insects that pass at least part of their life in the soil.

A. Anterior end. *p ex*, excretory pore; *valv*, valvula of terminal bulb. About 533×.

B. Sketch of the amphid. *amph gl*, amphidial gland; *amph p*, amphidial pouch; *term*, terminals.

C, D. Formed contents as seen in the intestine.

E. Front view of head end. *amph*, amphid; *dors subm lab pap*, dorso-submedial labial papilla; *lat cph pap*, lateral cephalic papilla; *seta*, seta of unknown significance. About 1090×.

F. Tail end of larva. *phas*, phasmid. About 120×.

G. Tail end of adult female. About 120×.

H. Tail end of male. *1–14*, various papillae; *brs msc*, bursal muscles; *dct ej*, ductus ejaculatorius; *prot gub*, protractor gubernaculi; *prot sp*, protractor spiculi; *retr gub*, retractor gubernaculi; *retr sp*, retractor spiculi. About 485×.

I. Tail end of male, ventral view. About 533×.

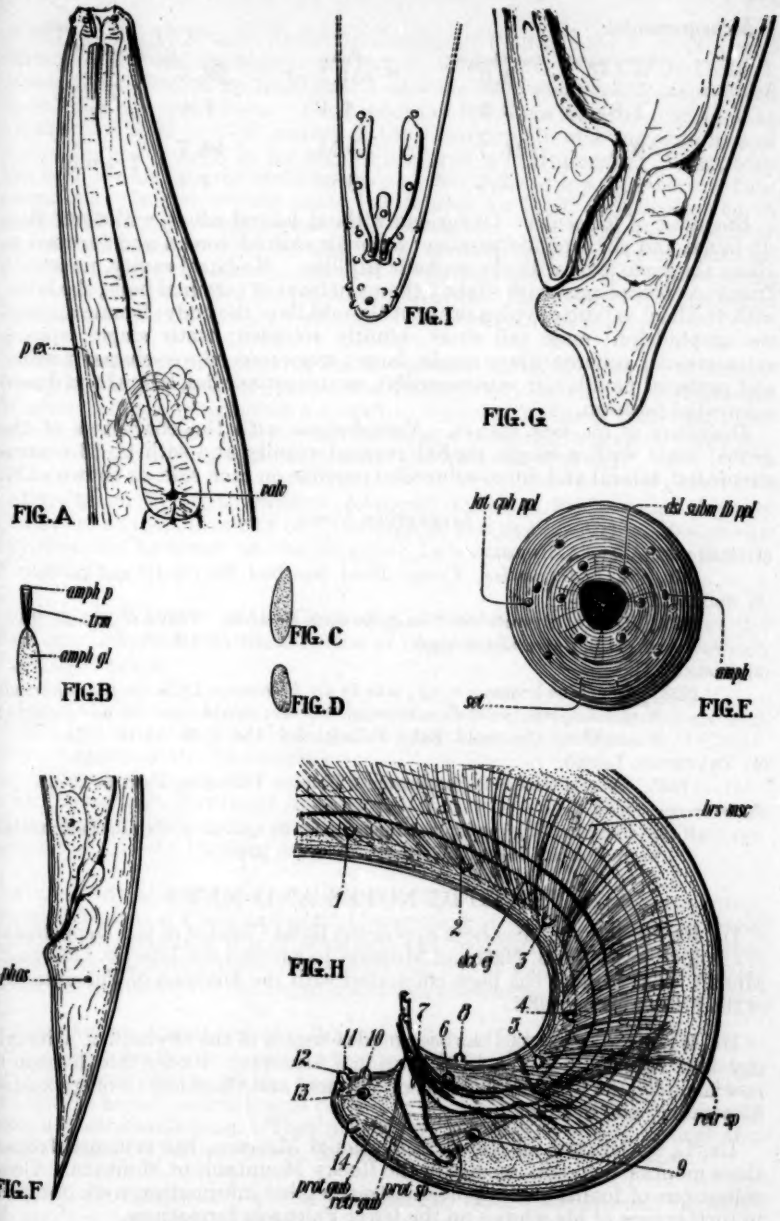

Figure 1.—*Neoaplectana glaseri*, n. g., n. sp.

Measurements:

	Nerve-ring	Oesophagus	Vulva		
♀	2.3	3.9	$^{45}-51.5-^{44}$	98.8	4.7 mm.
♀	1.8	2.2	4.4	1.4	
♀	9.5	16.7	−M	96.7	1.4 mm
♀	4.4	5.3	6.6	4.4	

Diagnosis of the genus. Oxyuridae without lateral wings, with three lips, six labial and six cephalic papillae; amphids shifted dorsad and forward to about the same level with the cephalic papillae. No bucal cavity, no mouth armature, oesophagus with slight isthmus in front of terminal bulb; the latter with vestigial valvulae; vulva in about the middle of the body; female apparatus amphidelph; male tail short, bluntly rounded; testis single; spicula symmetrical; gubernaculum single, large; numerous nipple-shaped preanal and postanal papillae in ventro-medial, ventro-submedial, lateral and dorso-submedial position.

Diagnosis of the new species. Neoaplectana with the characters of the genus; male with a single medial preanal papilla and with 11–13 ventro-submedial, lateral and dorso-submedial papillae on each side, as shown at H.

LITERATURE CITED

(1) RAILLIET, A. and A. HENRY.
1916. *Sur les Oxyuridés.* Compt. Rend. Soc. Biol. **79:** 113–115 and 247–250.

(2) SEURAT, L. G.
1920. *Histoire naturelle des Nématodes de la Berbérie.* Travaux du Lab. Zool. générale, Université d'Alger.

(3) STEINER, G.
1923. Aplectana kraussei *n. sp., eine in der Blattwespe* Lyda *sp. parasitierende Nematodenform, nebst Bemerkungen über das Seitenorgan der parasitischen Nematoden.* Centralbl. Bakt. Parasitenkd. Abt. 2, **59:** 14–18. illus.

(4) TRAVASSOS, LAURO.
1927. *Sobre o Genera* Oxysomatium. Boletim Biologico, Fasc. **5:** 20–21.

(5) ———
1927. *Una nova Capillaria parasita de peixes de agua doce;* Capillaria sentinosa *n. sp.* Boletim Biologico Fasc. **10:** 215–217. illus.

SCIENTIFIC NOTES AND NEWS

Dr. RAY S. BASSLER has been appointed Head Curator of the Department of Geology in the U. S. National Museum to succeed the late Dr. George P. Merrill. Dr. Bassler has been connected with the Division of Paleontology of the Museum since 1901.

Dr. WILLIAM F. FOSHAG has been made Curator of the Division of Mineralogy and Petrology in the U. S. National Museum. Under this division is now included the former Divisions of Physical and Chemical Geology and of Mineralogy and Petrology.

Dr. C. E. RESSER, of the U. S. National Museum, has returned from a three months' field trip, mostly in the Rocky Mountains of Montana. Good collections of fossils and important stratigraphic information were obtained in furtherance of his studies on the lower Paleozoic formations.

ELLSWORTH P. KILLIP, Associate Curator of Plants in the U. S. National Museum, and his associates, ALBERT C. SMITH and WILLIAM J. DENNIS, report the collection up to August 1 of some 5400 numbers of plants from little known parts of Peru. The expedition left Lima April 15, collected at altitudes of 3000 to 4700 meters in the Departments of Lima, Junín, and Ayacucho, particularly in the regions of Tarma and Huancayo. Later work has been confined to the eastern slopes of the Andes at low and intermediate elevations. In October the party left Iquitos for Pará, and is expected to reach Washington about the middle of December. The collections will be of especial value not only for the addition of material from new regions but also for the topotypic material it contains of species hitherto imperfectly known and scantily represented in American herbaria. The work of the party has been expedited at all times by officials of the Peruvian government.

Dr. REMINGTON KELLOGG, of the Division of Mammals, and Mr. NORMAN BOSS, of the Division of Vertebrate Paleontology of the U. S. National Museum, are spending about a month in western Alabama collecting fossil mammals. The work is being carried on as a coöperative project under the auspices of the Carnegie Institution and the National Museum.

Dr. RALPH T. K. CORNWELL, formerly Assistant Professor of Organic Chemistry at the University of Pittsburgh, is now Senior Microanalyst in the Division of Chemistry at the Hygienic Laboratory, U. S. Public Health Service.

Dr. A. J. WATTERS of the University of St. Andrews, Scotland, is at the Hygienic Laboratory in the Division of Chemistry, under a Commonwealth Fund Fellowship.

Dr. RAYMOND M. HANN, formerly of the Department of Agriculture and Mellon Institute is now at the Hygienic Laboratory in the Division of Chemistry, engaged in sugar researches.

Dr EDWARD P. BARTLETT has resigned from the Fixed Nitrogen Laboratory, Bureau of Chemistry and Soils, Department of Agriculture, to become associated with the Du Pont Ammonia Corporation.

Mr. KNOWLES A. RYERSON, in charge of the Office of Foreign Plant Introduction, Bureau of Plant Industry, Department of Agriculture, has returned from a plant-collecting trip in Manitoba and Saskatchewan, Canada. Material of several native fruits and ornamental plants was obtained, and will be tested out at stations of the Department and elsewhere.

Mrs. AGNES CHASE, of the Bureau of Plant Industry, left New York October 19th for Rio de Janeiro, where she will be joined about 10 days later by Mrs. YNES MEXIA of the California Academy of Sciences. Mrs. Chase will devote herself to study and collection of grasses, while Mrs. Mexia will make a general collection. They plan to work westward mostly through the campo country of Minas Geraes, Goyaz, and Matto Grosso to Cuyaba.

Dr. H. B. HUMPHREY, a plant pathologist in the Department of Agriculture, has been elected president of the Botanical Society of Washington for the coming year.

Dr. SAMUEL PALKIN of the Office of Drug Control, of the Food, Drug and Insecticide Administration, Department of Agriculture, has been transferred to the Industrial Farm Products Division of the Bureau of Chemistry and Soils, in the same Department, to carry on fundamental research on turpentine and rosin.

Dr. WILLIAM S. FRANKLIN, since 1917 professor of physics at the Massachusetts Institute of Technology, has become professor of physics at Rollins College.

The Educational Courses of the Bureau of Standards, which began on September 30, comprise courses in theoretical mechanics, theory of functions, integral equations and allied topics, introductory atomic physics, chemical mathematics, the theory of probabilities and its applications, and ceramic petrography.

The Graduate School of the Department of Agriculture opened on October 21, courses being offered on composition of the soil, fundamentals of chemistry, colloid chemistry, control of plant diseases, plant genetics, advanced statistical methods, history of American agriculture, prices and price relationships, principles of taxation, and economic aspects of weather and agriculture. Undergraduate courses are being given on elementary statistical methods, principles of systematic botany, agricultural writing, Spanish, and scientific French.

WILLIAM H. JACKSON, pioneer photographer of the Union Pacific Railroad and the United States Geological Survey under Hayden, though now well along in his 80's, has been engaged the past summer in locating parts of the exact course of the old Oregon Trail, along many miles of which he walked, photographing Indians and natural features, before the advent of the transcontinental railroads.

Yale University is putting up a building to house the Institute of Human Relations, in which scientific studies will be made of child development, mental reactions, psychology, motivation, social relations and similar matters pertaining to human welfare.

With the probability that further large oil pools exist at greater depths than have heretofore been drilled, and with present shut-in reserves, the advances in chemical technology by which more gasoline is produced from the same quantity of crude, and the facility with which one kind of fuel can be transformed into another, the possibility of a shortage of gasoline now seems rather remote.

The principal industrial disease in South Africa, according to Prof. W. E. DIXON's statement before the British Association for the Advancement of Science, is silicosis—brought about by inhaling silica dust in the gold mining districts. The mode of action of the silica is not well understood, but it seems to promote tuberculosis and Bright's disease.